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(71) Applicant (*for all designated States except US*): DIRECT RADIOGRAPHY CORPORATION [US/US]; Glasgow Business Community, Route 896, P.O. Box 6101, Newark, DE 19714-6101 (US).

(71)(72) Applicant and Inventor: CROWELL, John, Arnold [US/US]; 3319 Breidablik Drive, Wilmington, DE 19807 (US).

(74) Agents: CURFISS, Robert, C. et al.; Bracewell & Patterson, LLP, Suite 2900, 711 Louisiana Street, Houston, TX 77002-2781 (US).

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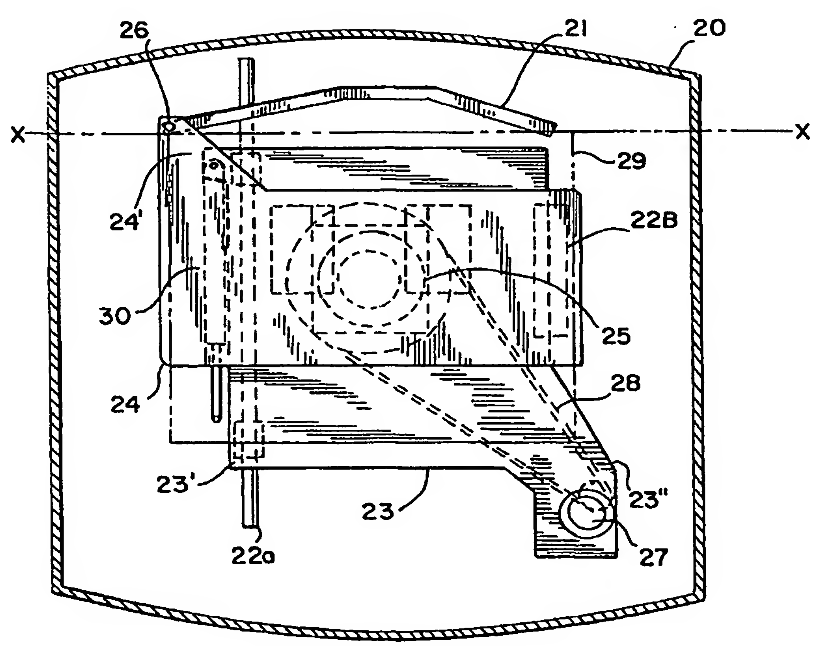
(54) Title: APPARATUS AND METHOD FOR POSITIONING A DIGITAL X-RAY DETECTOR ARRAY

(57) Abstract

An apparatus for automatically positioning and orienting a digital X-ray detector array and synchronizing movement of the digital X-ray detector array with an X-ray emission apparatus to provide simultaneous rotational and translational array movement between a first landscape position and a second portrait position, along a reference axis common to both. Dual plates are attached to one another via a bearing. The first plate (23) is disposed for translational movement along guide rails (22). A motor (27) attached to the first plate is used to rotate the second plate (24) relative to the first plate. As the second plate rotates, a cam follower (26) is forced to move along a cam track (21). The shape of the cam track is designed to result in translational movement of the overall system as the cam follower moves along the cam track.



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APPARATUS AND METHOD FOR POSITIONING A DIGITAL X-RAY DETECTOR ARRAY

Field of the Invention

This invention relates to a system for taking digital X-rays. More particularly, this invention relates an apparatus that automatically positions and orients a digital detector array to permit either landscape or portrait image format.

Background of the Invention

For over 60 years, X-ray film, in combination with intensifying screens, has been the standard for capturing and displaying medical X-ray images because of said film's functional utility and perceived high image quality. X-ray film has been vital to this process in that, X-ray film has performed the functions of capture, display, storage, and communication of the image data.

Over the years, there have been advances in X-ray techniques which have moved X-ray technology away from traditional X-ray film and toward digital X-ray capture devices. Some of these advances include computed tomography, and ultrasound and nuclear medicine, which gained widespread acceptance in the 1970's. In the 1980's, magnetic-resonance imaging and digital subtraction angiography furthered the trend toward digital imaging. Even with these advances, an estimated 70% of all diagnostic examinations are still performed using conventional radiography with traditional screen-film systems.

Until recently, all efforts to integrate conventional radiography into the digital environment have required both intermediate conversion steps and additional work by the technicians. Current developments have made it technically possible and economically viable to use electronic equipment to supplant film for three of film's four functions--image display, storage and communication. With these advances, high luminance display monitors, combined with high performance personal computers and workstations, are now available to assist in this image capture and integration process. Electronic image archives can more effectively store and retrieve the massive amounts of image data generated by an X-ray imaging facility. High speed electronic networks can transmit image files wherever and whenever needed. One important factor in the development of digital X-ray imaging systems has been an effective method for capturing high resolution X-ray image data in a digital format. The solution has been the digital image capture array.

Digital image capture arrays use radiation sensors to convert incident radiation directly to an electrical charge. Typically such sensors comprise a complex structure which includes a bottom and a middle conductive electrode separated by a dielectric to form a capacitor, a photo conductive layer over one of the electrodes and a top electrode over the photo conductive layer to apply a charging voltage to the sensor. The structure thus forms two capacitors connected in series. A voltage is applied between the bottom and top electrodes charging the two capacitors. Upon exposure to radiation, the photo conductor becomes conductive altering the charge distribution in the two capacitors. With proper selection of electronics and materials, this results in a charge accumulated and stored in the capacitor formed by the bottom and middle electrodes which is proportional to the exposure to the incident radiation.

In this device, a plurality of sensors may be assembled in an array of rows and columns to form a radiation detection panel. By sequentially reading out charges accumulated in the individual sensors, an image of the relative exposure of different areas of the panel is obtained. This image represents the radiation intensity incident on the panel after it has passed through a subject illuminated by the radiation. Use of X-rays in this manner to produce an image of a patient results in an image called a radiogram in which a plurality of charges represents the image.

Fig. 1 shows the basic concept of the direct X-ray process that results from this technology. An electronic cassette **5** containing an image capture element **6** is placed in a first position much like a standard screen-film cassette is used to receive a first image. A target **7**, i.e., a patient in the case of medical diagnostic imaging, is positioned in an X-ray beam path **8** emitted by a source of X-radiation **9**. The radiation emerging through the target **7** is imagewise modulated in intensity based on the varying degree of X-ray absorption in the target **7**. The pattern of this imagewise modulated radiation is captured and stored by image capture element **6** contained in the electronic cassette **5**.

The core component of this technology is the image capture element. As previously mentioned, the electronic cassette **5** typically houses the X-ray image capture element **6**. Element **6** can comprise a plurality of discrete array modules juxtaposed in an assembly over the top surface of a base plate, such that each module is disposed adjacent at least one other module to form a two-dimensional mosaic of modules. Each of the discrete modules includes a plurality of thin-form transistors arrayed adjacent the top surface of a dielectric substrate. A continuous radiation detecting layer is disposed over the plurality of juxtaposed modules, and produces a latent radiographic image in the form of electrical charges. When X-ray sensors, in the electronic cassette, sense the presence

of X-radiation followed by absence of X-radiation, a process of digitizing the plurality of electrical charges begins within the X-ray image capture element. This plurality of charges is converted within readout electronics to produce a plurality of digitized image element values, and these values are transferred to an electronic memory storage means located in the electronic cassette. When it is desired to read out the data recorded in memory means, the digitized image element values are directed to a central control unit.

One specific electronic cassette uses an amorphous selenium-coated thin-film-transistor (TFT) array to capture and convert X-ray energy directly into digital signals. This direct X-ray technology provides a full field 14 inch by 17 inch imaging area using a 2560 x 3072 matrix of detector elements. Under a bias voltage applied across the detector structure, incident X-rays directly generate electron-hole pairs in the selenium layer. These charges are collected by individual storage capacitors associated with each detector element within the detector array for readout by customized electronics. The result is a digital image that can be immediately reviewed on a video monitor and once accepted, can be forwarded via a network for soft and hard copy display, data storage and transmission to other locations. The technology is well described in a number of publications and issued patents, which include U. S. Patent No. 5,319,206 issued on June 7, 1994 to Lee et al., U.S. Patent No. 5,381,014 issued on January 10, 1995 to Jeromin et al., and U. S. Patent No. 5,652,430 issued July 29, 1997 to Lee.

This new direct digital X-ray system clearly advances X-ray technology to another level. An observation of the steps required to implement the direct X-ray technology and the steps required to implement the traditional screen-film technology illustrates the advantages of direct X-ray technology. Screen-film systems rely on the indirect process of X-ray-to-light-to film to create an image. This requires several steps which include:

1) X-ray photons exit the target and pass through the phosphor materials in the intensifying screens which absorb incident X-ray energy and fluoresce.

2) The emitted light exposes the film emulsion creating a latent image. Some light energy scatters and sensitizes the emulsion in areas not directly in the path of the original incident X-ray. This can degrade image sharpness.

3) The latent image is made visible by processing the film with developer and fixer chemistries.

In contrast, the direct digital X-ray process involves only one step:

1) X-ray photons exit the anatomy and are captured directly as digital signals by the detector array. In seconds, the digital signals appear as an image on a monitor for diagnosis. This digital image can be easily output to film.

The use of direct digital image capture obviates the need for phosphors, scintillators or intermediate steps, and results in little or no light diffuse or scatter within the detector. Thus, direct X-ray technology provides a faster and better quality X-ray. With direct digital radiography, patients are able to use the most convenient location in a network for their examination and are assured that the procedure will be accurately and quickly completed. In addition, patient images can be forwarded wherever they are needed. In direct-to-digital image capture systems, the image data sent to workstations, printers and archives is always substantially identical to the original. The all-digital radiology department will help hospitals, imaging centers, private practices, and clinics realize the full benefits of a picture archiving, windowing and communication system. Changing health care needs require diagnostic imaging service providers to rapidly produce the highest quality images, transmit them broadly, display them in alternative ways, and then archive and retrieve them efficiently. To accomplish this, direct-to-digital X-ray image capture becomes the critical link in the chain.

Although recent technology developments have made it possible to create digital images, there is still a need for automation of certain steps in the digital imaging process. For example, there is still a need to automatically position and orient the digital array cassette for either landscape or portrait images. Traditionally, radiographs are either taken in landscape format, i.e., the major axis of the image is horizontal, or in portrait format, i.e., the major axis of the image is vertical, the particular format selected being dependent on the nature of the target being X-rayed. In the past, switching between the two image formats has required a technician to physically remove the cassette from the cassette holder and reorient the cassette in the desired position. The same is also true of alignment of the X-ray emission apparatus with the cassette. Clearly, both are time consuming and prolong the entire X-ray procedure, including the X-ray exposure time for both patient and technician. Therefore, it is desirable to have an apparatus that can automatically position image capture equipment, in particular the detector array as well as the X-ray emission apparatus, to permit a particular X-ray image format.

Summary of the Invention

It is an object of this invention to provide an apparatus that can automatically position an X-ray capture cassette for either landscape or portrait images.

It is another object of this invention to ensure the ability to reference an image array regardless of the orientation of that image array.

It is another object of this invention to automatically synchronize movement of an X-ray emission apparatus with an X-ray detector apparatus

The present invention provides a system for positioning and orientating a digital X-ray detector array for the purpose of taking a digital X-ray. The invention provides both rotational and translational movement between a first and a second position. This flexibility in movement permits a generally rectangular shaped X-ray imaging array to rotate from a first position, such as a portrait position, to a second position, such as a landscape position.

The present invention has a carriage plate and an array plate. These plates provide the translational and rotational movement of the invention, respectively. The carriage plate connects, via a guide rail, to a fixed base and moves vertically along the base. This ability to move vertically facilitates the translational movement of the invention. The array plate attaches to a bearing mounted between the array plate and the carriage plate. A follower cam on the array plate engages a cam track that is fixed to the base. As the array plate is rotated relative to the carriage plate, the cam follower moves along the cam track and the carriage plate is urged along the guide rails. This translational and rotation movement permits orientation of the X-ray detector array. A drive means connected to the carriage plate and the bearing via a pulley actuates rotational movement in the array plate, and thus, the subsequent translational movement in the carriage plate.

Description of the Drawings

FIG. 1 is an elevation view of the basic concept of the direct X-ray process.

FIG. 2 is a diagram of the typical room layout of a digital imaging system for a chest X-ray;

FIG. 3 is a front cross-sectional view of the image positioning system of the present invention;

FIG. 4a, 4b and 4c depict a sequence of rotational and translational movements by the invention;

FIG 5 is a side cross-sectional view of the image positioning system of the present invention;

FIG 6 is a top cross-section view of a drive means of the present invention;

FIG 7 illustrates the location of the translational-rotational carriage when used in an X-ray table; and

FIG 8 is view of the X-ray table and the housing containing the detector array.

Detailed Description of the Preferred Embodiment

The present invention is illustrated in the context of a system that performs a chest imaging application. A brief explanation of the chest imaging system will precede the description of the present invention. This system, shown in Fig. 2, incorporates both hardware and software components in acquiring a digital image. A stand **10** houses the direct X-ray detector array **11** within a counterbalance receptor holder **12**. The stand **10** provides adjustable, easily accessible array positioning controls and a rotation-translations carriage system for the X-ray detector array **11**. One novel feature of the invention is that the rotation-translational system enables technicians to position the X-ray detector array **11** to accommodate a full range of X-ray images. Another novel feature of the invention is that the position and orientation of the detector array is automatically synchronized with the position of the X-ray tube housing **14**. The X-ray tube stand **13** comprises an X-ray tube housing **14**, an automatic collimator (not shown) within the X-ray tube housing and servo linkages (not shown) to the receptor holder.

The operator console (also known as the "Direct X-ray Operator Console) is the user interface component of the system. Most operator functions are accomplished at the operator console. The operator console also provides the control functions responsible for synchronizing the ready states of the detector array and the X-ray equipment. The operator console can include a computer with an image view monitor **15**, peripheral pointing device **16**, keyboard **17**, a direct X-ray array controller **18**, system CPU **19**, network connections **19a** and electronics cabinet **19b**.

Radiologic technicians use the operator console to input patient information, examine data, and acquire, preview, and transmit images and associated text information from the direct X-ray system to hardware and software display devices. Users can customize certain features of the operator console to meet their specific needs. For example, operators can define frequently used image rejection comments or informational comments. Then, the operators can attach one or more of these predefined comments to an image file by simply selecting them from a dialog box. The system may include other peripheral devices such as printers and DICOM storage, workstations and archive devices, additional user interfaces and an anatomical pre-programmed exposure.

Referring to Figs. 2, 3 and 6, the present invention focuses on the carriage holding the direct detector array **11** housed in the receptor holder **12** that is attached to the stand **10**. Specifically, the receptor holder **12** houses a fixed base **20**. Attached to the fixed base **20** is a cam track **21**. Also attached to the base are guide rails **22a** and **22b**. Slidingly mounted on guide rails **22** is carriage plate **23**. Pillow blocks or bearings **23'** (Fig. 6) are attached to the bottom of one side of the carriage plate **23** to secure carriage plate **23** to guide rail **22a** and to counter any torque placed on carriage plate **23** by the rotational movement of array plate **24**. The other side of carriage plate **23** need not have pillow blocks, but may simply rest and slide directly on guide rail **22b**. The sliding of carriage plate **23** along guide rails **22** permits the translational movement necessary to properly orient the X-ray imaging array **29**.

Rotatingly mounted on carriage plate **23** is a bearing **25** which is also attached to the array plate **24** such that array plate **24** is rotatable relative to carriage plate **23**. Array plate **24** is provided with a tang **24'** that extends over cam track **21** to permit a cam follower **26** mounted on tang **24'** to move along cam track **21** as array plate **24** is rotated between first and second positions. In a first position, shown in Fig. 4a, array plate **24** is orientated so that cam follower **26** is substantially at the left-most potion of track **21**. In the second position, shown in Fig. 4c, array plate **24** is rotated clockwise 90 degrees until cam follower **26** is substantially at the right-most portion of track **21**.

A bi-directional motor **27** is mounted on tang **23"** which forms a part of carriage plate **23**. Motor **27** drives a belt **28** that is attached to the rotatable portion of bearing **25**. As motor **27** is actuated, belt **28** causes bearing **25**, and hence array plate **24**, to rotate either clockwise or counter clockwise 90 degrees between its two positions. For example, beginning in the first position as shown in Fig. 4a of the drawings, clockwise rotation of motor **27** causes clockwise rotation of array plate **24**. As array plate **24** rotates, cam follower **26** moves along track **21** to the right. In doing so, carriage plate **23**, being attached to array plate **24** by way of bearing **25**, is forced along guide rails **22** away from cam track **21**. When an array plate **29** is mounted on the carriage plate, vertical movement of carriage plate **23** moves the array plate **29** in the vertical direction while the array plate **29** rotates. Also shown in Fig. 3 is a tension cable **30**.

More specifically, when an X-ray imaging array **29** is attached to array plate **24**, the X-ray imaging array can be moved between a first position and a second position by rotating the array plate. In the first position, shown in Figs.3 and 4a, the long edge Z of array **24** is aligned along axis x-x. In the second position, shown in Figs. 4c, the short edge Y of array **29** is aligned along axis x-x.

One of the purposes of the invention is to ensure that either the long edge Z or the short edge Y of array **29** is always aligned along horizontal axis x-x when array **29** is in an imaging position, thus permitting axis x-x to be used as a common reference for all images. In addition, this permits proper alignment of the center of the X-ray beam emitted from X-ray tube housing **14** and the detectors utilized in the system's automatic exposure control (not shown) incorporated into array **29**. The vertical movement of the detector array is accomplished through the carriage plate as previously explained.

Figures 4a, 4b and 4c show the sequence of movement required to reposition and reorient the digital array **29** between the first and second positions. In Fig. 4a, the carriage plate **23**, which is disposed for translational movement, is proximal to cam track 21. The array plate **24**, which is disposed for rotational movement, is oriented so that array **29** is in the horizontal or landscape position. In Fig. 4b, the system is illustrated in a transitional position between the first and second positions. Specifically, as the motor **27** rotates in a clockwise direction, the pulley system causes the bearing **25** to rotate in the same clockwise direction. This movement results in the array plate rotating in a the clockwise direction. During rotation, the cam follower **26** moves along the cam track **21** to guide the array plate translation.

The rotation of the bearing **25** also causes the carriage plate **24** to move vertically away from cam track **21** along the guide rails **22**. Fig. 4c shows the second position of carriage plate **24** and array **29**. As shown, the array **29** is in vertical or portrait position in which short edge Y is aligned with the x-x axis. The cam follower **26** has moved to the rightmost end of the cam track **21**. The end of cam track **21** inhibits any further movement of cam follower **26** and thus also functions to restrict any further translational movement of carriage plate **23**. The carriage plate **23** is now in a distal position relative to cam track **21**. This new position of the two plates could be desirable when taking an X-ray of a patient.

Fig. 5 shows a side cross-sectional view of the invention. As shown, the X-ray imaging array **29**, the array plate **24**, the motor **27**, and the bearing **25** are all directly or indirectly supported by the carriage plate **23**. Each of these elements is disposed for translational movement along guide rails **22** by way of carriage plate **23**. Fig. 5 also shows the physical relationship of the array plate **24**, the cam track **21**, and the cam follower **26**.

Fig. 6 shows a top cross-section view of the invention. Most readily shown in this figure are bearing **25** and guide rails **22** in relation to the carriage plate **23**.

Figs. 7 and 8 show an alternate embodiment of the present invention in which the system is disposed in a drawer **33** mounted under an X-ray table **32**. In this embodiment, table **32** has an X-ray source **31** positioned above table surface **32'**. The detector array **29** is positioned in a drawer **33** which is slidably attached below the table surface **32'**.

As shown in Fig. 8, drawer **33** is slidably attached to table **32** to permit access to array **29** and the invention. However, access to array **29** is not typically necessary since the invention obviates the need to manually open drawer **33** to switch array **29** between portrait and landscape positions. In a preferred embodiment, the invention can simply be inserted into X-ray film cassette drawers of conventional X-ray tables without the need for modification of the drawers or tables. Thus, X-ray tables that have in the past required manual array reconfiguration can be easily and quickly converted to automatic reconfiguration utilizing the current invention.

Although, the invention has been illustrate and describe utilizing a single motor to drive the system, those skilled in the art will understand that other drive systems can be employed without effecting the spirit of the invention. In one embodiment, a direct drive motor can be used to cause rotation of bearing 25 rather than the pulley driven system described herein. In another embodiment, rather than driving the system by rotation in a fashion that ultimately results in translation, the system can be driven by translation that secondarily results in rotation. Thus, a drive system could be used to propel carriage **23** along guide rails **22**, forcing cam follower **26** to move along cam track **21**. Furthermore, those skilled in the art will understand that although this system is most desirable for digital x-ray capture arrays, it can also be utilized in conventional X-ray systems that utilize film to record images.

The apparatus of this invention provides significant advantages over the current art. The invention has been described in connection with its preferred embodiments. However, it is not limited thereto. Changes, variations and modifications to the basic design may be made without departing from the inventive concepts in this invention. In addition, these changes, variations and modifications would be obvious to those skilled in the art having the benefit of the foregoing teachings. All such changes, variations and modifications are intended to be within the scope of this invention, which is limited only by the following claims.

We claim:

1. An apparatus for positioning and orienting a digital detector array used in the process of taking an X-ray comprising:

a) a first plate, said first plate having top and bottom sides and said first plate being able to move in a translational direction;

b) a second plate overlaying said first plate, said second plate having top and bottom sides said second plate being able to rotate in both clockwise and counter-clockwise directions;

c) a connecting means for attaching said first plate to said second plate, said connecting being rotatingly mounted onto said first and second plates such that said connecting means is between said first and second plates; and

d) a drive means attached to said connecting means for causing rotation of said second plate and translation of said first plate.

2. The apparatus of claim 1 further comprising:

e) a support base, said base being attached to the bottom side of said first plate;

f) a cam track attached to said base to guide rotation of said second plate; and

g) guide rails attached to said base and said first plate to facilitate translation of said first plate.

3. The apparatus of claim 2 further comprising bearings to connect said first plate to said guide rails.

4. The apparatus of claim 3 wherein said first and second plates have tang portions.

5. The apparatus of claim 4 wherein said bearings attach said first plate to said guide rails at said tang portion of said first plate.

6. The apparatus of claim 2 further comprising a cam follower to connect said second plate to said cam track.

7. The apparatus of claim 6 wherein said cam follower is connected to said second plate at a tang portion of said second plate.

8. The apparatus of claim 1 wherein said drive means comprises a motor and a belt, said belt being attached to said connecting means.

9. The apparatus of claim 8 wherein said connecting means is a bearing.

10. The apparatus of claim 8 wherein said motor is a bi-directional motor.

11. The system of claim 8 wherein drive means is at least two motors, one motor to facilitate the rotational movements of said second plate and one motor to facilitate the translation of said first plate.

12. The apparatus of claim 2 further comprising an X-ray imaging array attached to said second plate, said X-ray imaging array being able to capture an X-ray image.

13. The apparatus of claim 1 wherein said second plate, said connecting means, and said drive means are carried by said first plate in the direction of the movement of said first plate during the translational movement of said first plate.

14. The apparatus of claim 13 wherein said rotation of said second plate occurs during the translation of said first plate.

15. An apparatus for positioning a digital detector array used in the process of taking an X-ray comprising :

a) a table having a surface on which a patient is positioned;

b) a carriage for positioning and orienting a cassette used in the process of taking an X-ray, said carriage comprising:

i) a first plate, said first plate having top and bottom sides and said first plate being able to move in a translational direction;

ii) a second plate overlaying said first plate, said second plate having top and bottom sides said second plate being able to rotate in both clockwise and counter-clockwise directions;

iii) a connecting means for attaching said first plate to said second plate, said connecting being rotatingly mounted onto said first and second plates such that said connecting means is between said first and second plates; and

iv) a drive means attached to said connecting means for causing rotation of said second plate and translation of said first plate.

c) a housing, to contain the carriage and the cassette, said housing slidably mounted to said table below said table surface; and

d) a means to move said detector array housing along said table surface in a parallel direction to the position of said patient.

16. The apparatus of claim 15 further comprising:

e) a support base, said base being attached to the bottom side of said first plate;

f) a cam track attached to said base to guide rotation of said second plate; and

g) guide rails attached to said base and said first plate to facilitate translation of said first plate.

17. The apparatus of claim 16 further comprising a cam follower to connect said second plate to said cam track.

18. A method for positioning an X-ray cassette used in the process of taking an X-ray comprising the steps of:

a) automatically rotating an X-ray cassette for taking an X-ray; and

b) simultaneously automatically translating the X-ray cassette to a desired position.

19. The method of claim 18 further comprising the step of automatically synchronizing movement of the X-ray cassette with an X-ray emission apparatus.

20. The method of claim 19 wherein said step of synchronizing includes the step of translating the X-ray emission apparatus to maintain alignment with the X-ray cassette.

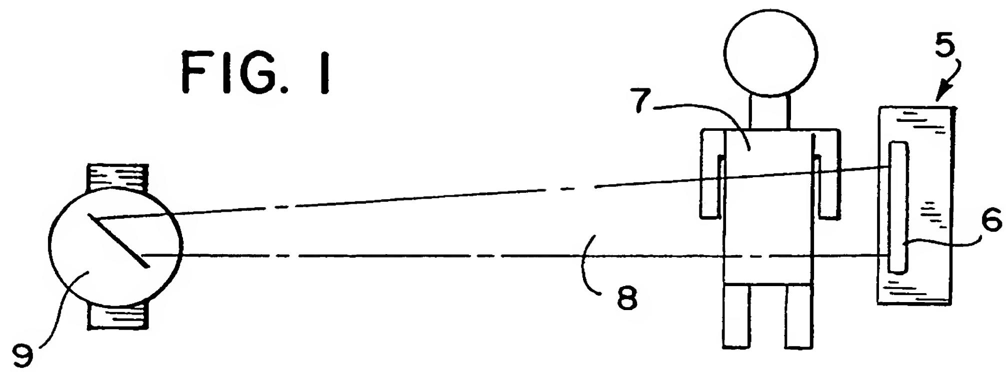
21. A method for positioning an X-ray cassette used in the process of taking an X-ray comprising the step of :

a) synchronizing translational movement of an X-ray emission apparatus and an X-ray cassette.

22. The method of claim 21 wherein said step of synchronizing further comprises the steps of vertically moving an X-ray emission apparatus and vertically moving an X-ray cassette to positions where the X-ray emission apparatus and the X-ray cassette are aligned.

23. The method of claim 21 wherein said step of synchronizing further comprises the steps of horizontally moving an X-ray emission apparatus and horizontally moving an X-ray cassette to positions where the X-ray emission apparatus and the X-ray cassette are aligned.

FIG. 1



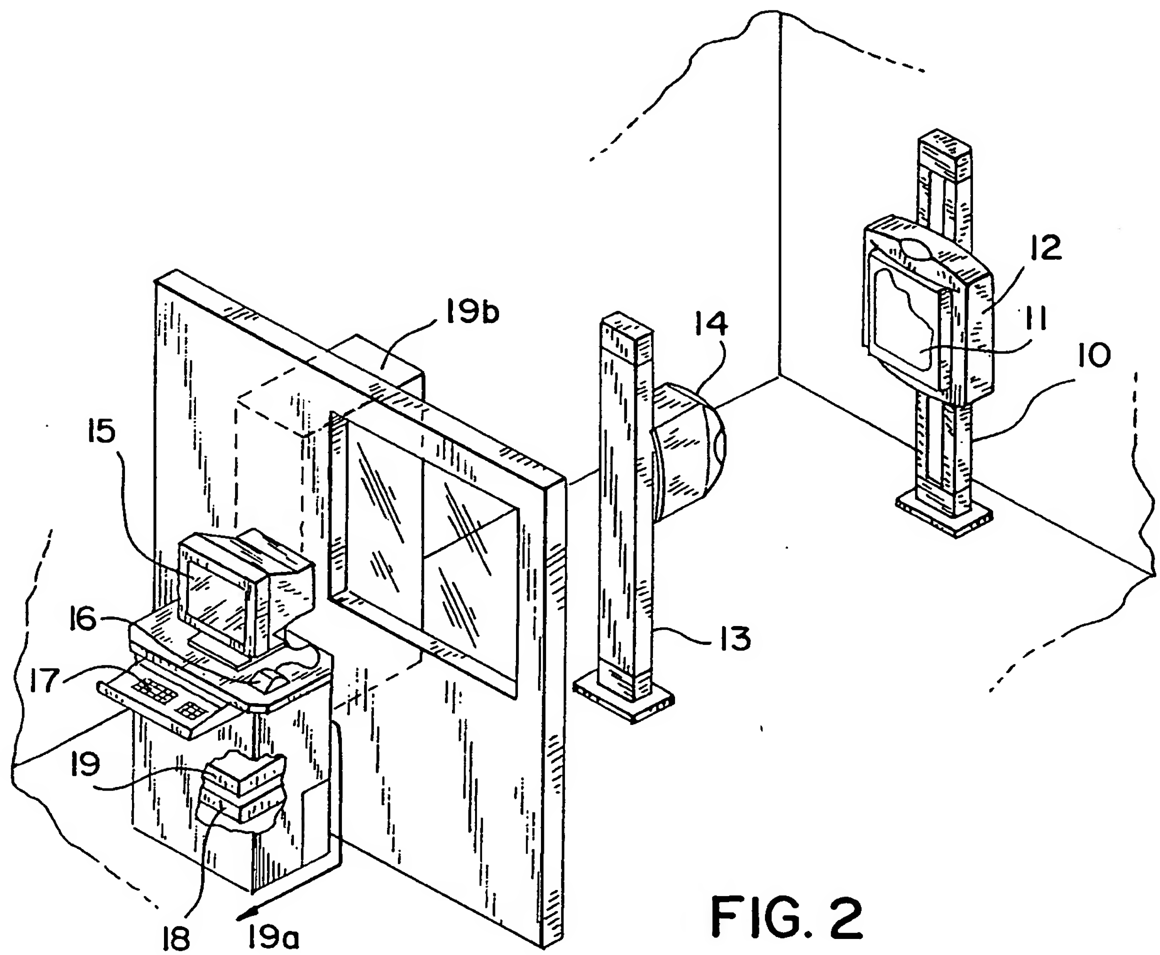


FIG. 2

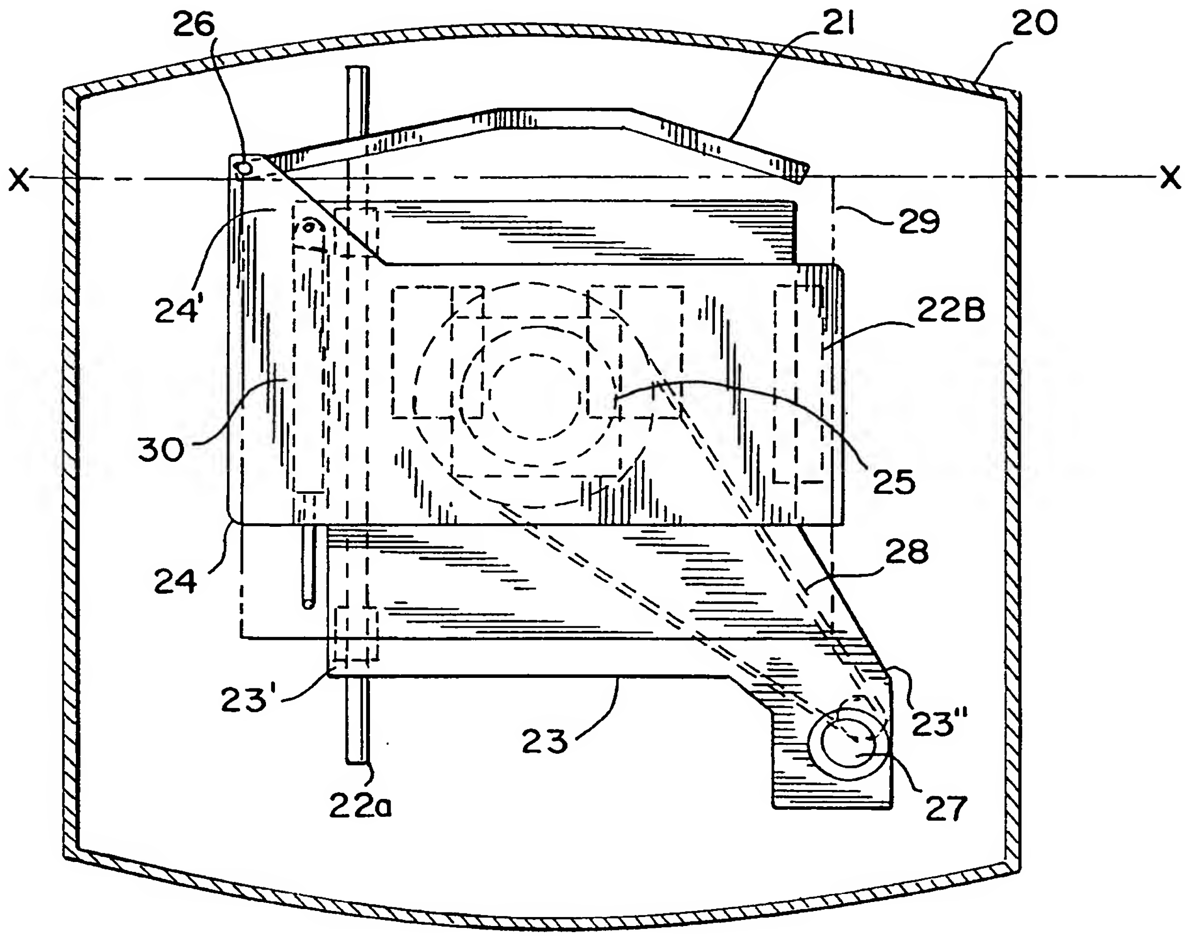


FIG. 3

FIG. 4A

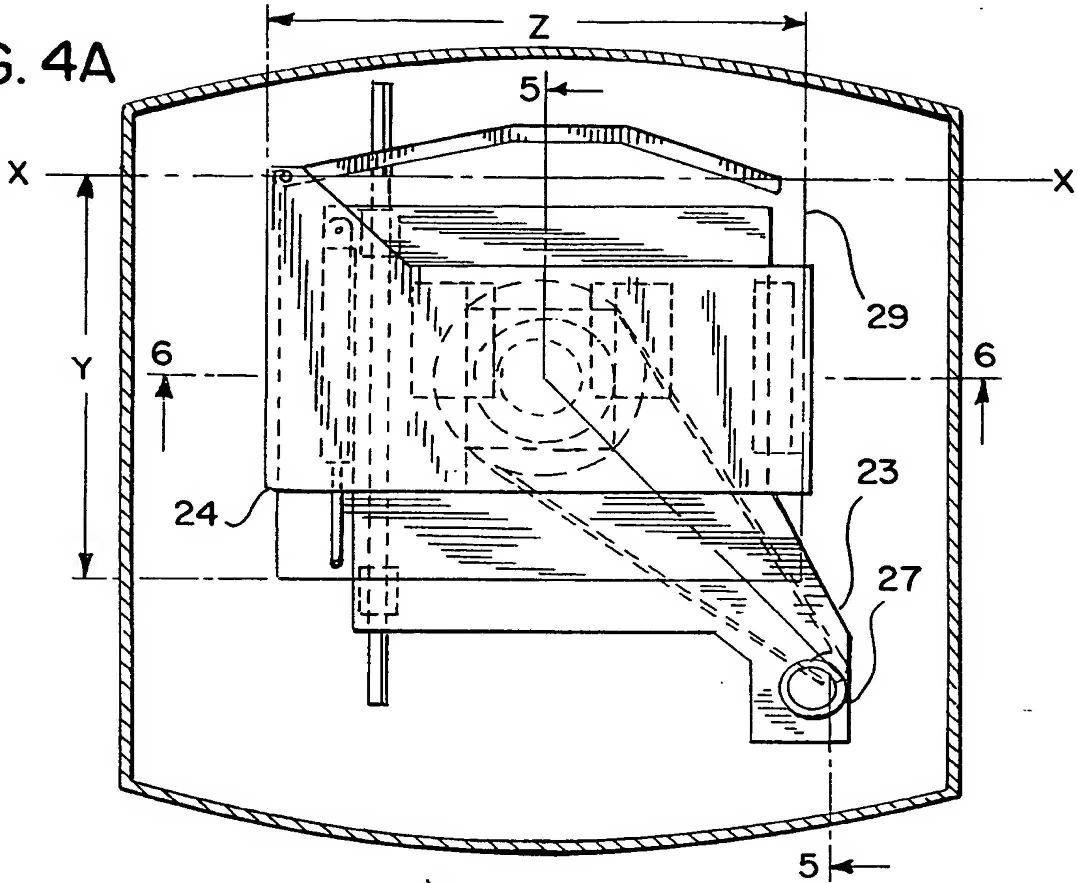


FIG. 4B

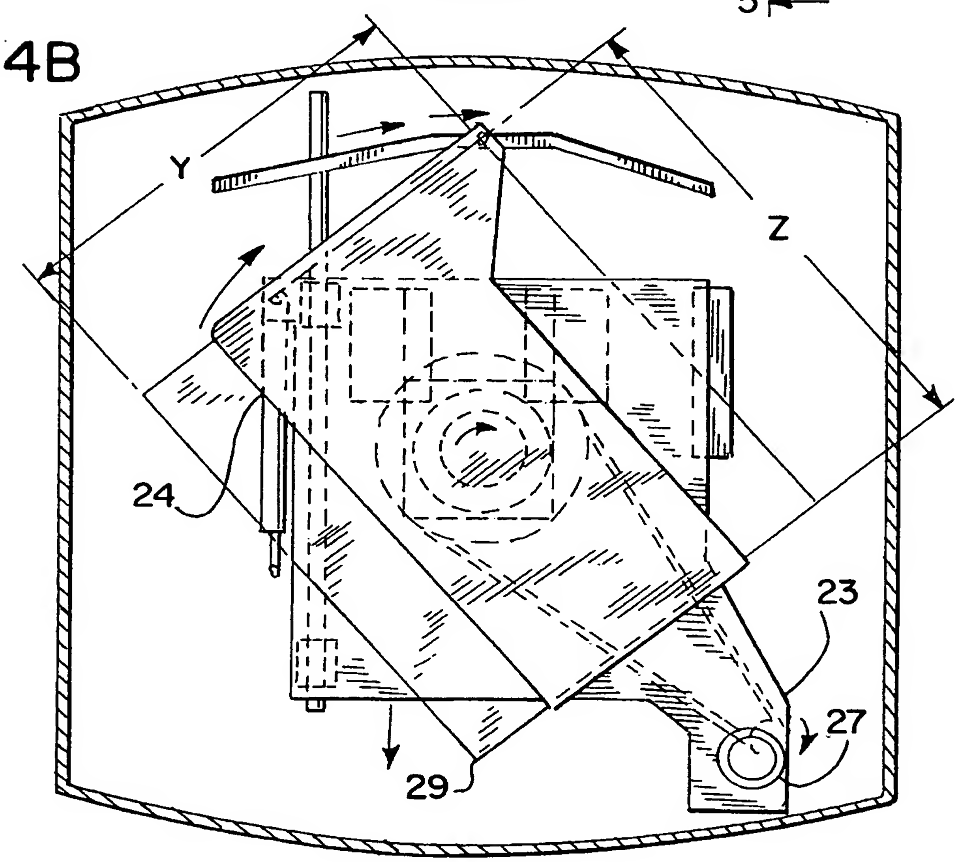


FIG. 4C

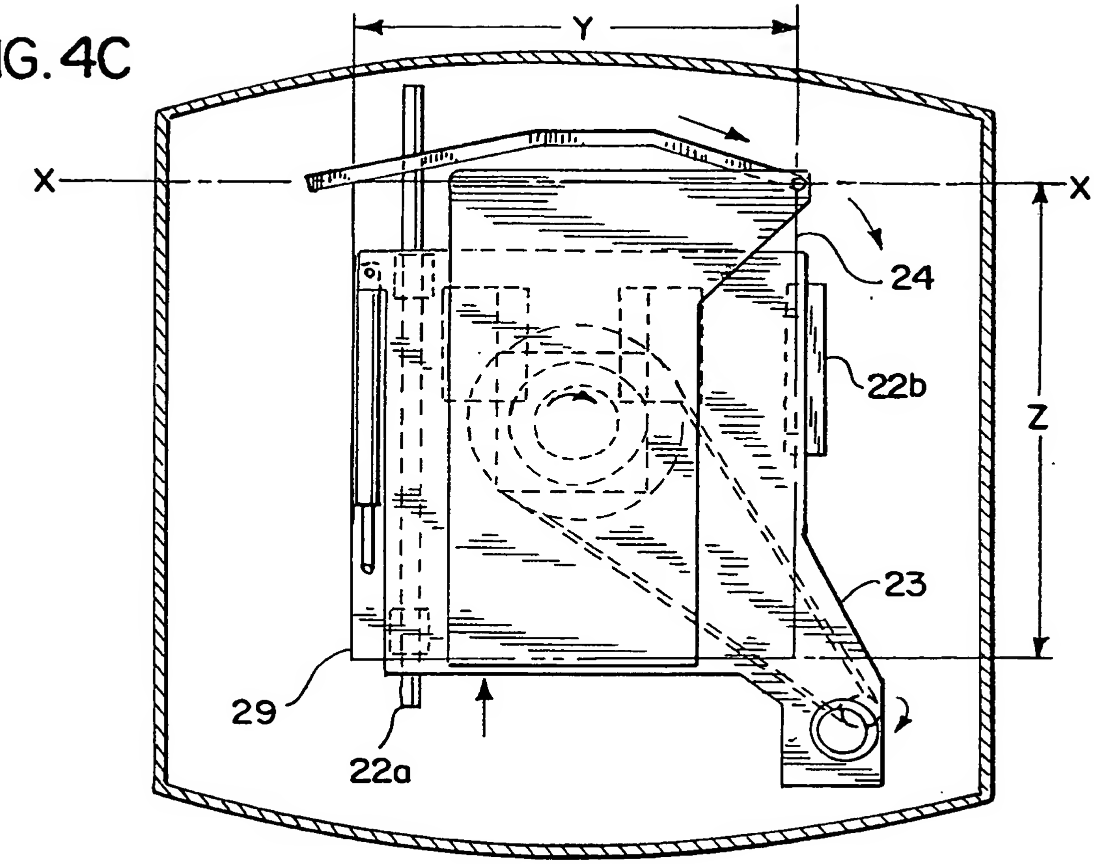
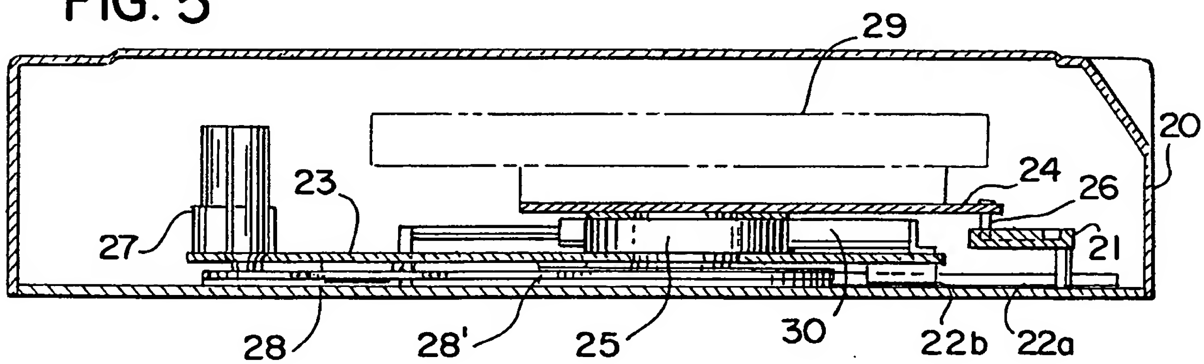


FIG. 5



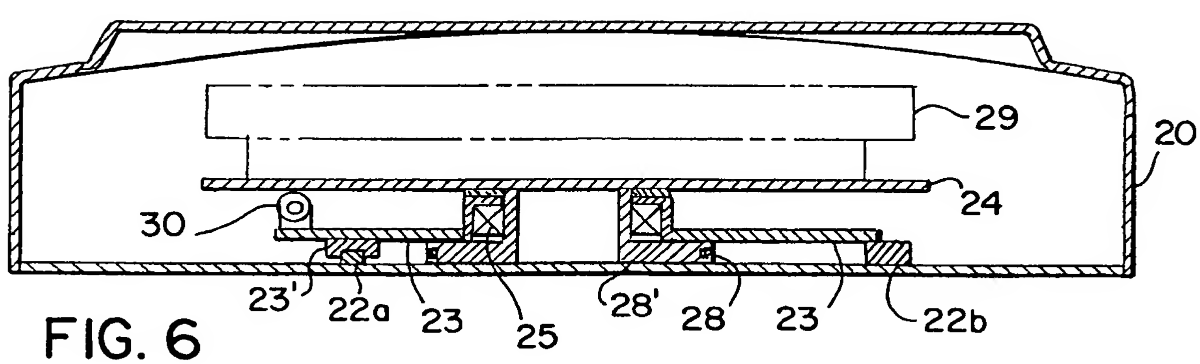
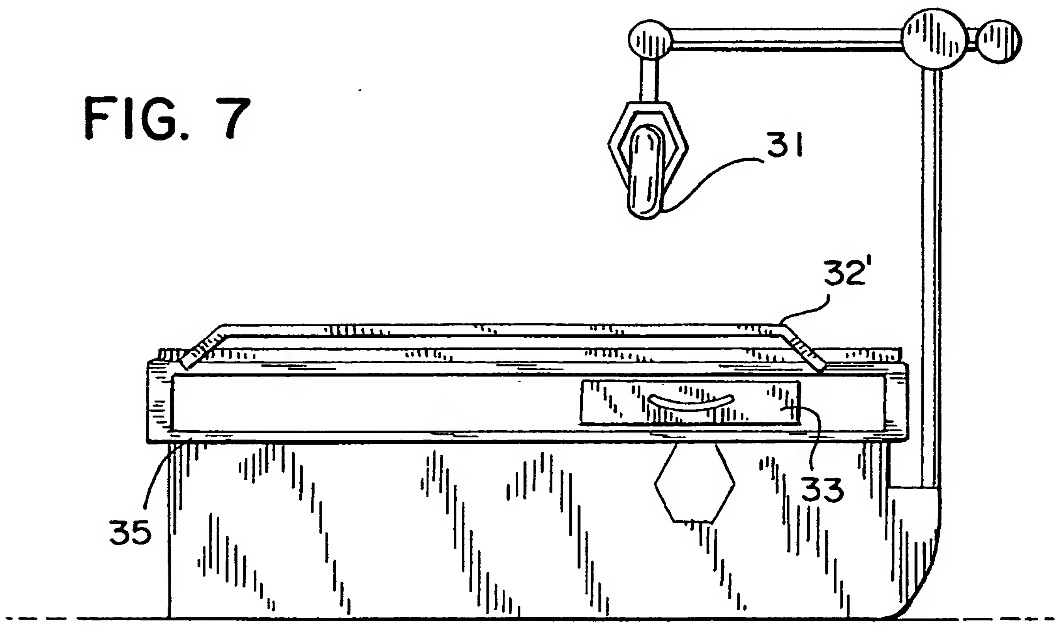


FIG. 6

FIG. 7



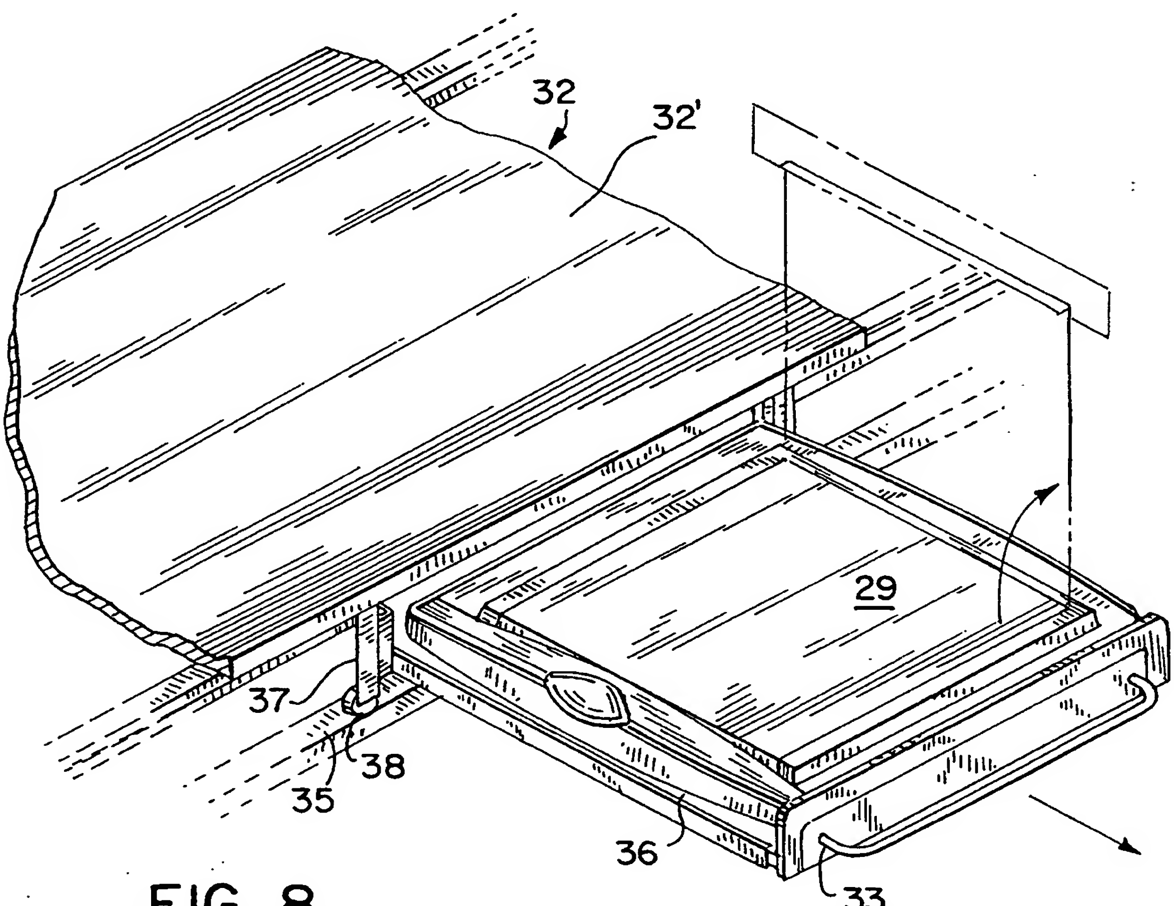


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/25534

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :G03B 42/02
US CL :378/205
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
U.S. : 378/167, 181, 204, 205

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- A	US 4,300,053 A (GUYNES) 10 November 1981 (10.11.1981), entire document.	1,8-11, 13-15 -------- 2-7, 12, 16-20
X	US 5,572,567 A (KHUTORYANSKY et al.) 05 November 1996 (05.11.96), figure 2.	21-23

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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Date of the actual completion of the international search
10 JANUARY 2000

Date of mailing of the international search report
03 FEB 2000

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231
Facsimile No. (703) 305-3230

Authorized officer
DAVID P. PORTA
Telephone No. (703) 308-0956